WE CLAIM:

1. A method, comprising:

mixing a precursor in a carrier;

transforming the precursor to form a metal or metallic compound after mixing the precursor in the carrier;

transporting the metal, metallic compound or precursor to a surface of a nanostructure substrate in the carrier while the carrier is in supercritical fluid form; and

forming a nanocomposite comprising the nanostructure substrate and the metal or metallic compound.

2. The method of claim 1, wherein the carrier is a gas at room temperature and atmospheric pressure.

3. The method of claim 1, wherein the carrier comprises carbon dioxide.

4. The method of claim 1, wherein the precursor comprises a metal-β-diketone complex and transforming the precursor comprises reducing the metal-β-diketone complex.

5. The method of claim 1, wherein the nanostructure substrate comprises substantially cylindrical nanostructures with a median diameter between about 2 nm and about 100 nm.

6. The method of claim 1, wherein the nanostructure substrate comprises a carbon nanotube.

7. The method of claim 1, wherein the nanostructure substrate comprises a nanowire.

8. The method of claim 1, wherein the nanostructure substrate comprises a pore of a mesoporous material.

9. The method of claim 1, further comprising separating the nanostructure substrate from the carrier, and wherein transforming the precursor comprises transforming

the precursor on the surface of the nanostructure substrate after separating the nanostructure substrate from the carrier.

10. The method of claim 1, wherein transforming the precursor comprises transforming the precursor in the carrier to form free-floating nanoparticles comprising the metal or metallic compound, and the method further comprises:

mixing the carrier with a surfactant; and

depositing the nanoparticles onto the surface of the nanostructure substrate by reducing the temperature and/or pressure of the carrier.

11. The method of claim 1, wherein transforming the precursor comprises transforming the precursor in the presence of an organic capping ligand.

12. The method of claim 1, further comprising separating the nanocomposite from the carrier by reducing the temperature and/or pressure of the carrier.

13. The method of claim 1, wherein mixing the precursor with the carrier comprises dissolving the precursor in a solvent.

14. The method of claim 1, further comprising introducing a reducing agent into the carrier, and wherein transforming the precursor comprises reducing the precursor.

15. The method of claim 14; wherein the reducing agent is hydrogen.

16. The method of claim 1, wherein the surface of the nanostructure substrate is an external surface and further comprising functionalizing the surface of the nanostructure substrate to promote attachment of the metal or metallic compound.

17. The method of claim 16, wherein functionalizing the surface of the nanostructure substrate comprises oxidizing the surface of the nanostructure substrate.

18. The method of claim 1, further comprising depositing the metal, metallic compound or precursor in a hollow interior of the nanostructure substrate, wherein the nanostructure substrate comprises a carbon nanotube or a pore of a mesoporous material.

19. The method of claim 18, wherein the nanocomposite comprises a nanowire or nanorod within the hollow interior of the nanostructure substrate.

20. The method of claim 1, wherein the nanostructure substrate is attached to a common structure and substantially aligned with a plurality of similar nanostructure substrates.

21. The method of claim 20, wherein the nanostructure substrate comprises a carbon nanotube.

22. A method for forming a catalytic structure, comprising:

mixing a precursor in a carrier;

transforming the precursor to form catalytic nanoparticles comprising a metal or metallic compound after mixing the precursor in the carrier;

transporting the catalytic nanoparticles or precursor to a surface of a nanostructure substrate in the carrier while the carrier is in supercritical fluid form; and

forming a nanocomposite comprising the nanostructure substrate and the catalytic nanoparticles.

23. The method of claim 22, wherein the nanostructure substrate comprises a carbon nanotube.

24. The method of claim 22, wherein the nanostructure substrate is attached to a common structure and substantially aligned with a plurality of similar nanostructure substrates.

25. The method of claim 22, wherein the catalytic nanoparticles comprise a metal selected from group consisting of: Cu, Ag, Ni, Pt, Pd, Co, Au, Ir, Rh, Fe, Ru, and combinations thereof.

26. A catalytic structure, comprising:

a nanostructure support; and

catalytic metallic nanoparticles attached to the nanostructure support, wherein the catalytic metallic nanoparticles are substantially evenly distributed on the nanostructure support.

27. The catalytic structure of claim 26, wherein the nanostructure support comprises carbon nanotubes.

28. The catalytic structure of claim 26, wherein the nanostructure support comprises substantially cylindrical nanostructures with a median diameter between about 2 nm and about 100 nm.

29. The catalytic structure of claim 26, wherein the nanostructure support comprises nanowires.

30. The catalytic structure of claim 26, wherein at least a portion of a surface of the nanostructure support is functionalized to promote attachment of the catalytic metallic nanoparticles.

31. The catalytic structure of claim 26, wherein the catalytic metallic nanoparticles have a substantially uniform distribution of diameters with a median diameter between about 2 nm and about 12 nm.

32. A fuel cell that comprises the catalytic structure of claim 26 configured to catalyze oxygen reduction or methanol oxidation in the fuel cell.

33. The catalytic structure of claim 26, wherein the nanostructure support comprises carbon nanotubes attached to a common structure.

34. The catalytic structure of claim 33, wherein the carbon nanotubes are substantially aligned on the common structure.